DOCUMENT RESUME

ED 297 982 SE 049 608

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TITLE Marine and Coastal Resources. Global Issues Education Packet.
PUB DATE 87
NOTE 24p.; For other packets in this series see SE 049 606-609. Contains photographs which may not reproduce well.
AVAILABLE FROM Global Tomorrow Coalition, 1325 E Street, NW, Suite 915, Washington, DC 20005 ($7.00 each packet, set of 5 packets $30.00).
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Biological Sciences; *Ecology; Elementary School Science; Elementary Secondary Education; *Environmental Education; Estuaries; Instructional Materials; Intermediate Grades; Marine Biology; *Marine Education; Middle Schools; Oceanography; *Science Activities; Science Education; Secondary School Science

ABSTRACT

At least 70% of the Earth is covered with water. This packet provides background information on eight areas of concern regarding marine and coastal resources. Considered are: (1) "Coastal Resources"; (2) "Mangroves"; (3) "Coral Reefs"; (4) "Ocean Resources"; (5) "Aquaculture"; (6) "Pollution"; (7) "Marine Debris"; and (8) "The Global Commons." Activities included in this packet are designed to increase students' awareness of these issues. Each activity includes a brief description, a concept statement, objectives, a list of relevant subject areas and skills, materials, and procedures. Several maps and worksheets for copying are included in this packet. Individual activity lessons include: "Common Concerns"; "Bringing up Baby"; "Polyp Pile-up"; "Mangrove Trees: Up to their Knees in Salty Seas"; "Sea of Debris"; and "Wave of the Future." A picture for coloring is also included. (CW)

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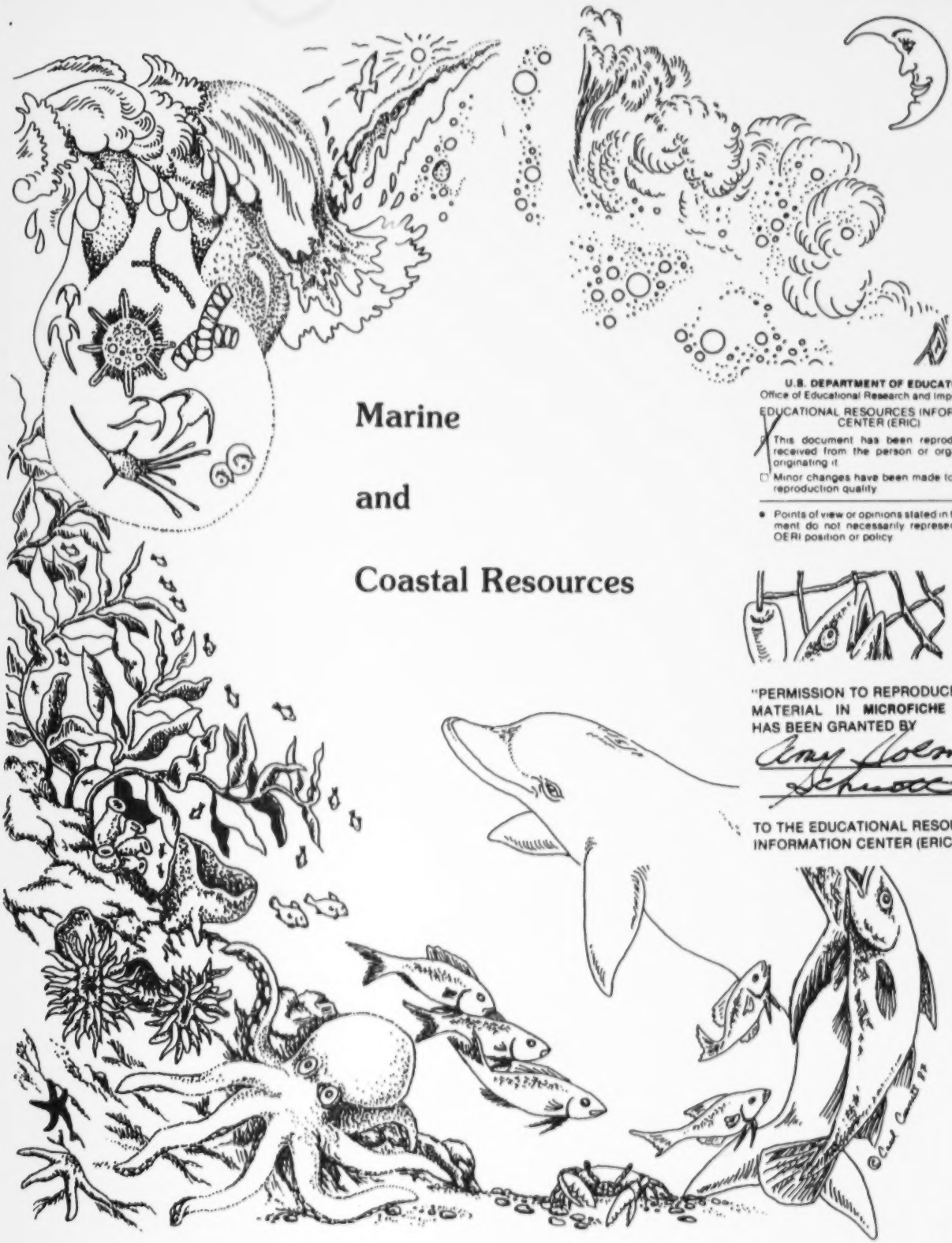

Marine and Coastal Resources

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This educational material was developed by Amy E. Holm, Coordinator of Education Services, Global Tomorrow Coalition. Special thanks to Donald R. Lesh for his editorial comments and prose; Bill and Diane Lowrie for use of their photographs; Carol Connett for her artwork; and Michael Weber, Cliff Curtis, Mary Barber, and Kristen Drucker for providing helpful comments and suggestions on the first draft.

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Marine and Coastal Resources Summary

I. Coastal Resources

At least 7/10 of the Earth is covered with water. Coastal ecosystems, including salt marshes, mangroves, estuaries, kelpbeds, and coral reefs, represent less than 15% of the total ecosystem. Coastal wetlands filter out pollution, soften the impact of storm waves and strong currents, prevent erosion of the coastline, and serve as "nurseries," providing nutrients to many marine species, such as shrimp, anchovies, and catfish.

II. Mangroves

Mangrove ecosystems, named for the hardy, salt-tolerant trees that dominate the ecosystem, are tidal wetlands comprising the fringes of more than half of all tropical shores. These areas support more than 2,000 species of fish and invertebrates, as well as epiphytic plants that grow on the mangrove trees. Nutrients released through the decomposition of mangrove leaves provide the first link in a long food chain culminating in open ocean fisheries. The extensive root system of the trees traps silt and prevents soil erosion. Only 1% of all mangrove systems is under some kind of conservation protection. The greatest threats to the mangroves are clear-cutting and landfill for development, diversion of fresh water by upland dams, and land reclamation for agriculture and aquaculture.

III. Coral Reefs

Coral, a living organism, flourishes in shallow tropical waters in temperatures of 25-29 degrees Celsius. Coral reefs, built of living coral on a framework of coral skeletons and rocks cemented together by clams, sponges, and mollusks, are very productive, diverse ecosystems providing both food and shelter for many life forms. Also, reefs help protect coastlines and supply sand to the tropical beaches. Careless anchoring of boats, negligent sport diving, overfishing, dynamiting of reefs to collect fish, commercial collection of coral to supply tourist markets with specimens and fine jewelry, siltation, sewage and thermal pollution, and nuclear testing are the leading causes of often irreversible damage to coral reefs.

IV. Ocean Resources

The ocean itself supplies people with many vital products. For instance, Japan depends on the ocean for 60% of its animal protein supply. Seaweed alone supplies a compound that is used in such end products as toothpaste, whipped cream, soft ice cream, deodorants, and shampoos. Scientists estimate that 70% of atmospheric oxygen is supplied by planktonic organisms. Many marine plants and animals have medicinal properties, such as the horseshoe crab whose freeze-dried blood is used to detect bacterial poisons in pharmaceutical products. The global fish catch includes cod, sole, herring, mackerel, lobster, shrimp, octopus, squid, tuna, salmon and certain marine mammals. Many fish products are consumed indirectly by North Americans and Western Europeans, because of the dominance of meat in their diet. One-third of the global fish harvest goes into animal feed supplements, such as fishmeal.

Marine and Coastal Resources Summary (con't.)

V. Aquaculture

As the world population grows and the availability of arable land declines, more people are turning to the sea for food, at the very time the global fish catch is shrinking. In industrialized nations, recognition of the health benefits from eating more fish than red meat is resulting in a significant increase in fish and shellfish consumption. In developing nations, people are looking for abundant and nutritious sources of food. Aquaculture -- or the farming of the ocean -- seems to offer the best hope in coping with the combination of growing demand for inexpensive protein sources, rising cost of commercial fish, and decline of species population due to overfishing. "Fish farming" has advantages over cattle raising in nutrition, productivity, and economy. Humans can metabolize more protein from fish then beef. Also, pound for pound, fish can be produced more cheaply then beef, because fish are cold-blooded and expend fewer calories for energy, live in a more supportive environment, and require less space.

Current attempts at aquaculture are targeting luxury foods, however, such as eel and shrimp, which require expensive feeding of prepared food. For greatest economy, fish farmers have to concentrate on species at the bottom of the food chain, which live off existing nutrients in the water. Limits on the future development of aquaculture, include the high property value of shoreline areas, the energy-intensive nature of the process, the increasing pollution of coasts, and the critical need for protection of certain coastal areas, such as salt marshes and mangroves, because of their environmental value to the ocean ecosystem.

VI. Pollution

Two-thirds of the human population lives in 1/3 of the world's land adjacent to coasts. 85% of ocean pollution derives from human activities on land -- agricultural run-off, urban sewage, and waste products from industry, nuclear reactors, and oil refineries. 90% of these pollutants remain in coastal waters, which are by far the most biologically productive sector of the ocean. For instance, the mangrove ecosystem is more than 20 times as productive as the open ocean. 1/3 of United States estuarine waters are now closed to shell fishing, because of toxic contamination due to sewage and industrial waste. In fact, DDT, a pesticide responsible for endangering the Bald Eagle, and other forms of wildlife, has been found in the fat of Antarctic penguins thousands of miles from the source. Coastal habitats are also being lost rapidly due to deforesta estation, waste disposal, salt pond construction, mining, dredge and fill operations, housing developments, and conversion to agricultural land.

VII. Marine Debris

For the past decade, concern has been growing among scientists, fishermen, and conservationists over the markedly increased volume of marine debris apparent in the world's oceans. Besides contributing to the aesthetic degradation of the coastline and beaches, the abundance of lost or discarded fishing line, gill netting, plastic six-pack rings, and glass debris are contributing to the mortality of several already endangered marine species, including fur seals, marine turtles, seabirds, and fishes. These species become entangled in or try to consume the man-made debris. Lost nets continue to capture fish, which no one can claim.

~ ~

VIII. The Global Commons

The exploitation, overharvesting, and pollution of the ocean ecosystem is reducing its productivity and harvestability. The abuse of the marine environment, often viewed as a limitless resource, provides a modern case study of the "tragedy of the commons." Ocean and coastal resources represent a common property that can be shared as an economic enterprise. But if each party seeks to maximize his or her own self-interest, competition for the scare resources will lead to their overexploitation. However, recognition of shared benefits and the common good can create new opportunities for cooperation.

Several global treaties dealing with the protection and use of marine resources have been adopted since 1958. In 1982, negotiations on a comprehensive Law of the Sea Treaty were completed, and it has been signed by 134 nations. 60 nations need to ratify the treaty formally before it becomes effective. So far, about 33 nations have done so, and it is likely that an additional 27 will ratify by 1990.

Unfortunately, some leading maritime nations, including the United States and West Germany, have refused to ratify the treaty because they oppose its provisions on seabed mining. Nonetheless, the treaty offers a practical framework for nations in dealing with marine pollution, implementation of exclusive economic zones (200 miles offshore areas), protection of navigational rights, and many other marine issues.

Regional efforts, such as the United Nations Environment Programme's Regional Seas Program, and regulations dealing with specific marine issues have been established and have proven to be successful in mobilizing collective action. Actions at every level -- local, regional, national, and international -- will be required to assure the sustainable development of the ocean and coastal resources for the global future.

Common Concerns

Students will learn about the difficulties of maintaining the health and productivity of a global common resource, and why it is necessary to do so, through participating in a simple marble game (45 minutes).

CONCEPT:
The global marine environment needs international cooperation and regulation, because of continued abuse and overharvesting.

OBJECTIVES:
(1) Identify (3) common resources.
(2) Define sustainable yield.
(3) Present (3) possible solutions to problem of overfishing.

BACKGROUND: none required

SUBJECT	SKILLS
• Social Studies	• identification
• Economics	• application

MATERIALS
- one large bag of marbles
- fish bowl or large glass jar

PREPARATION:
1. Before conducting the following activity with your students, review the theory about the human ecological predicament termed the "tragedy of the commons" for your own reference. See Garrett Hardin, "The Tragedy of the Commons," Science, Vol. 162, pp. 1243-1248 (1968).

PROCEDURE:
1. Brainstorm with students to identify natural resources, which are resources shared by all (e.g., air). Identify a common resource around your school, such as a playground, town square, or city park. No one individual owns it, yet everyone can share its value. What happens when people do not share or misuse the common resource? Play the next activity and find out.

2. Fill a fish bowl or large glass jar with marbles. Explain that this container holds a natural resource essential to the survival of the class. This natural resource is the common property of the entire class.

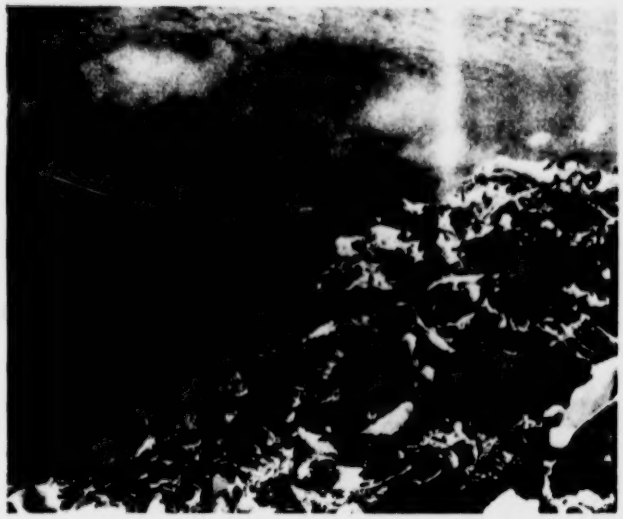
3. Each student will have a turn to extract a resource amount from the container. Students have the choice of removing 1 or more resources, but no more than 5 at a time. Each time a student takes a turn, place just one resource back in the jar or bowl, regardless of how many resources are removed. This represents the natural replenishment of a renewable resource.

4. Allow the students to discuss the state of the commons as they are playing. Do they realize that they are diminishing the resource if they all extract too much? Are they extracting at a higher rate than the resource is being replenished? Play 3-5 rounds or until the commons is depleted of resources.

CONCLUSION:

1. Ask the students what they have learned from the activity? What practices succeeded? What practices failed? Is anyone a winner or did everyone lose?

2. Compare this exercise to the issue of overharvesting the ocean's resources. Give facts about the global fishery intake. Brainstorm with students about ways to reach or maintain a sustainable yield of the fish resources based on their experience during the activity (e.g., fish farming, reducing amount of resource used in animal feed, etc.)



* The on-going discussions about the future of Antarctica clearly represents the dilemma of how to manage a global commons. As a class project, investigate the economic, political, and environmental interests in the Antarctica.

Bringing Up Baby

By studying data and a graph depicting the effect of pollution on animal species in a coastal wetlands habitat, students will learn about coastal areas and their importance as nurseries for marine species (35 minutes).

CONCEPT:
Coastal areas serve a unique purpose for marine life.

OBJECTIVES:
(1) Define habitats.
(2) Identify types of coastal wetland habitats.
(3) Define pollution.
(4) List (5) types of pollution.
(5) Define birth and death rates.
(6) Discuss (3) effects of wetlands destruction on people.
(7) Identify (5) ways of preventing pollution in coastal wetlands.

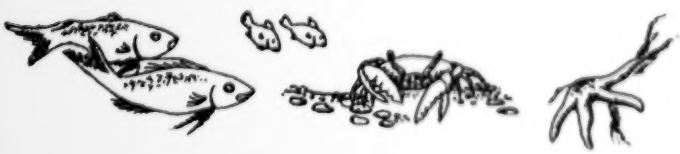
BACKGROUND: See "Common Concerns."

SUBJECT	SKILLS
• Mathematics	• graphs
• Social Science	• listing
• Natural Science	• application

MATERIALS
- Data Sheets*
- pens/pencils
- blackboard

PREPARATION:
1. Copy Data Sheets.

PROCEDURE:
1. Define habitat. Coastal wetland habitats are areas that are flooded by water so frequently that the water determines the types of plants and animals that live there. These habitats are called fresh water marshes, salt water marshes, mud flats, mangrove swamps, or estuaries. All of the habitats have the same quality: they are places where fresh water from the land meets salt water from the sea.



Explain the role of coastal wetlands as nurseries for many wildlife species, because they are protected from the ocean waves, rich in nutrients, and safe from ocean predators.

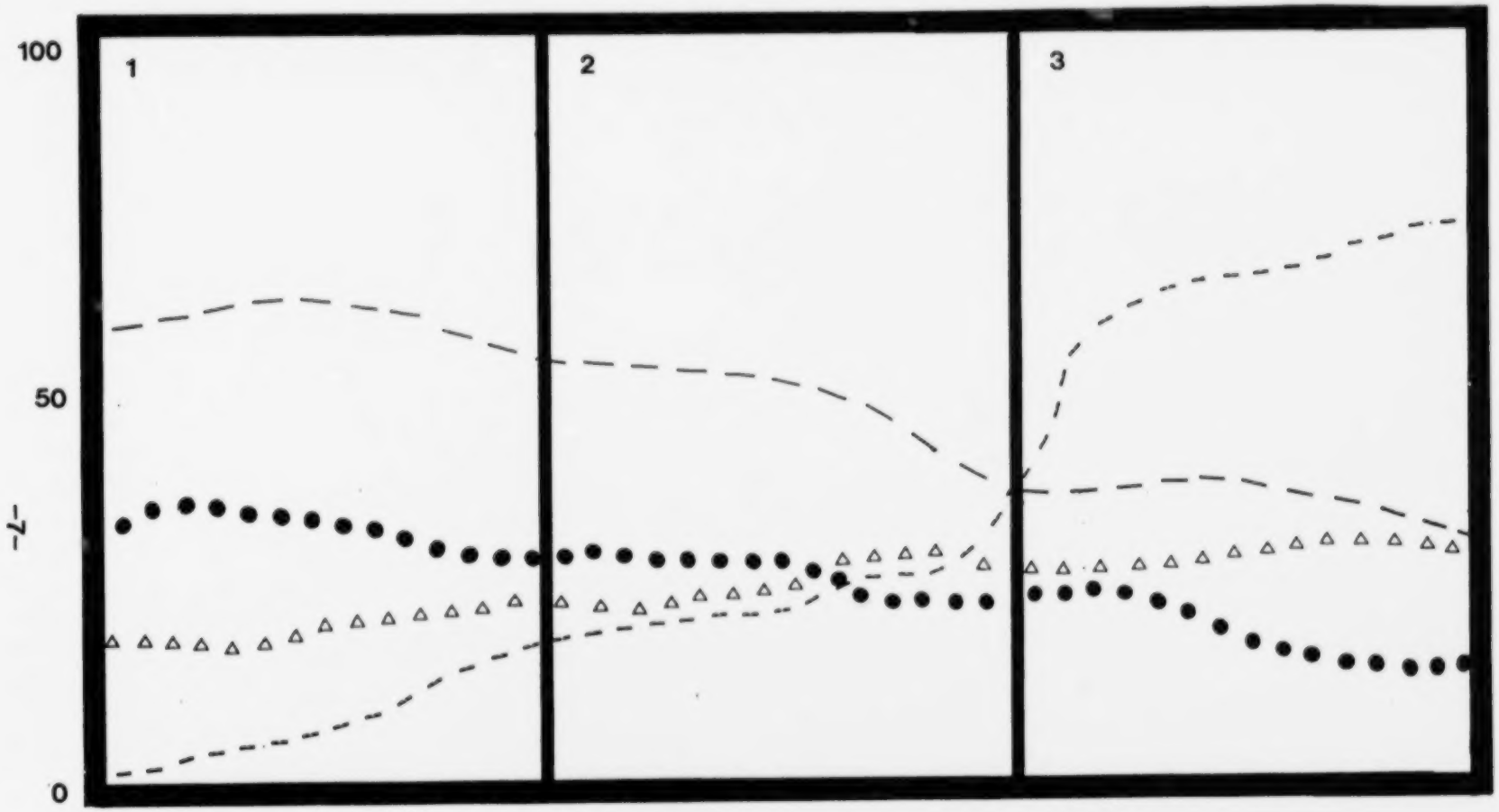
2. Define pollution. Brainstorm and list types of pollution, which can damage the coastal wetland habitat. What effects can pollution have on the animal species that hatch or raise their young in the wetlands nursery?

3. Distribute the data sheet to the students. Define birth and death rate. Ask the students to study and explain what is happening to the animal population in the different periods. Point out that the death rate increases rapidly, owing to the rise of infant mortality in the total population.

CONCLUSION:
1. Discuss the effects of polluted coastal wetlands on people. For instance, what happens to people if they consume fish from polluted waters? What happens to the fisherman who depend on the wetland nurseries to restock the fish and shellfish populations?

2. Identify ways of preventing the pollution of coastal wetlands and preserving these habitats.

EFFECTS OF POLLUTION ON ANIMAL POPULATIONS



TOTAL NUMBER
IN POPULATION — — —

NUMBER OF BIRTHS ●●●

TOTAL AMOUNT
OF POLLUTION - - -

NUMBER OF DEATHS △ △ △

Polyp Pile-up

Students will learn about coral and identify different types of coral through a matching activity and discussion (40 minutes).

CONCEPT: Coral reefs are an important part of both coastal and marine ecosystems.

OBJECTIVES:
(1) Define coral as living organism.
(2) Locate coral reef areas on map.
(3) Identify types of coral.
(4) Discuss (5) reasons for the destruction of coral reefs.

BACKGROUND: none required

SUBJECT	SKILLS
• Geography	• identification
• Natural Science	• matching
	• comprehension

MATERIALS
• Worksheet* • Coral Reef Map*
• pens/pencils

PREPARATION:
1. Copy worksheets and maps.

PROCEDURE:
1. Ask students if coral is a rock, a plant, or an animal? Explain that each coral animal is called a polyp, which is no bigger than a pea. There are two types of coral: hard and soft. Hard coral polyps live within a hard skeletal cup made of calcium. Soft coral polyps have an internal skeleton for protection.

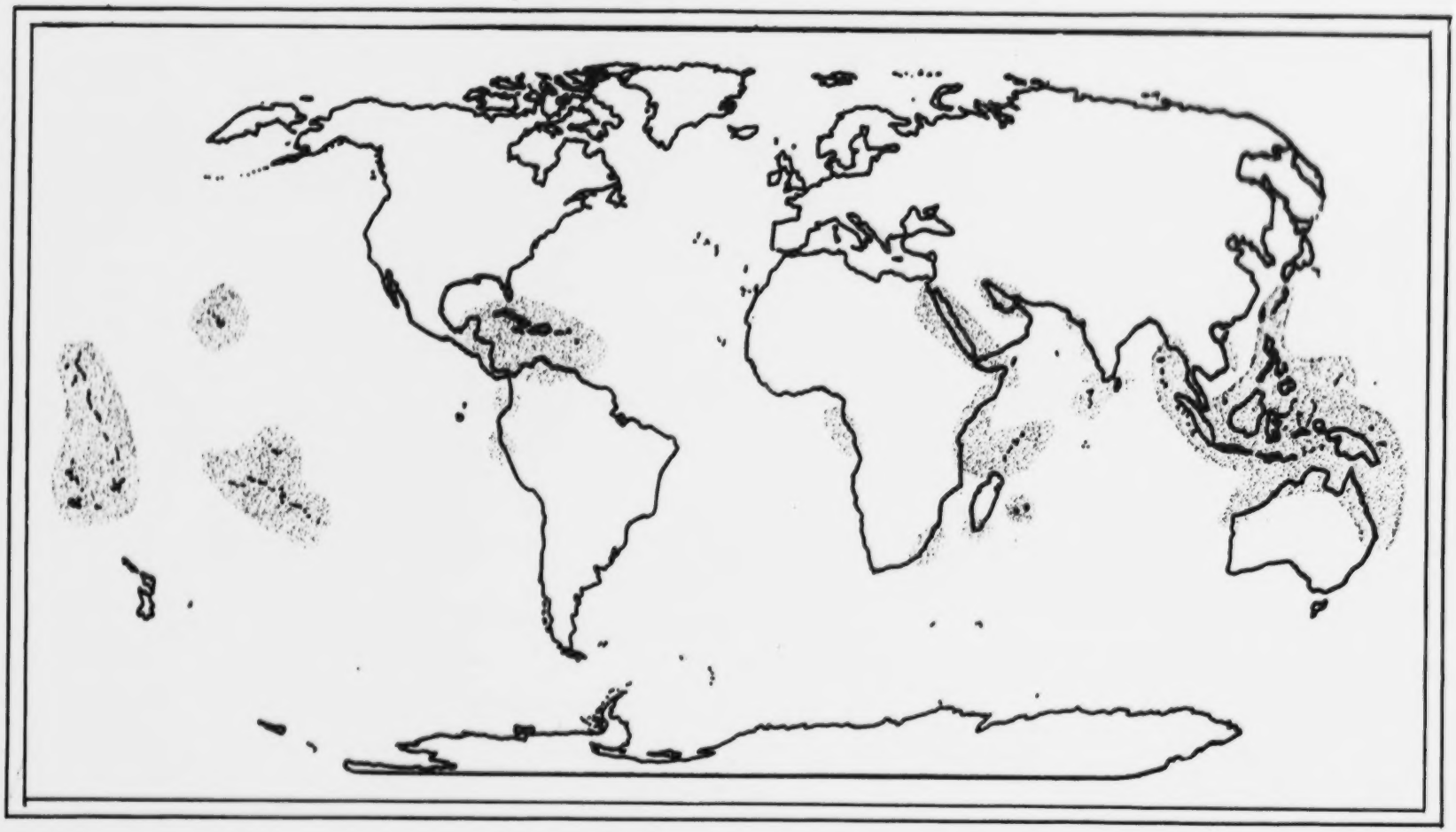
A coral reef is an underwater structure formed through a continual process of living coral organisms building upon the skeletons of dead coral polyps and cemented together by other organisms, such as sponges, barnacles, and clams. (One lb. of coral may contain over 37,000 polyp skeletons!)

2. Distribute map of coral reef areas and locate coral reefs. Globally, coral reefs cover approximately 600,000 square kilometers of ocean floor. These coral reefs support over 200,000 species. Note that coral live in warm, tropical areas and depend on clear water to receive adequate amounts of sunlight.

3. Pass out worksheets. Instruct students to try to connect the descriptive names of the coral to the correct pictures. Provide them with the right answers from the master sheet.

CONCLUSION:
1. After completion, discuss the information about coral reefs that the students learned from the worksheet. Explain that this diverse and fragile ecosystem is in danger because of human activities: coral mining to make substances such as concrete, overfishing, chemical and thermal pollution from agricultural run-off and industry, dredging, military testing, and selling coral to tourists for souvenirs.

CORAL REEFS



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Polyp Pile-up Worksheet

FLOWER

Coral reefs are found only in tropical oceans, because they need warm water and sun to grow.

GROOVED BRAIN

Coral reefs provide shelter, food, and nursery space for fish, lobsters, and many other species.

FINGER

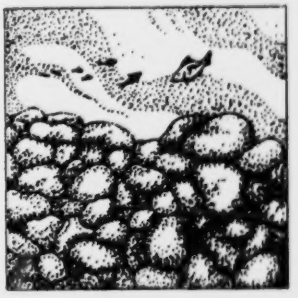
Sponges are animals that depend on the coral reef habitat. Before the use of synthetic sponges, people used these real sponges as cleaning tools.

ELKHORN

The coral animal is called a polyp, which is related to the jellyfish.

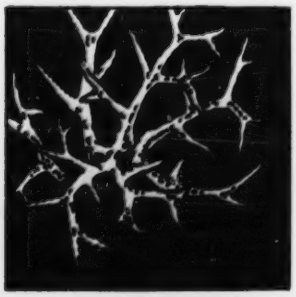
PILLAR

Coral reefs may grow as much as 1 centimeter per year, especially near the surface where there is more light.



STAGHORN

Coral reefs break down and provide the material for white sand on island beaches.



CACTUS

The coral reef is an interdependent system. When one factor is changed, such as the extinction of one animal, the whole reef may be endangered.

STAR

One of the main threats to coral reefs are tourists, who want to bring home coral souvenirs from their tropical vacations.

Polyp Pile-up Worksheet

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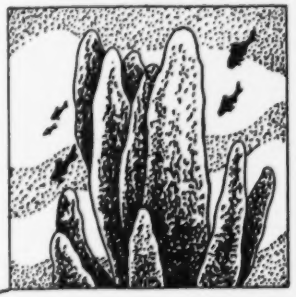

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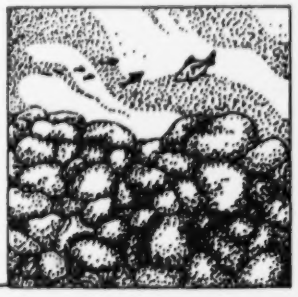

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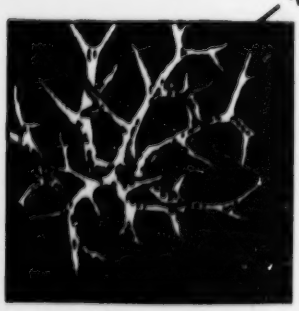


STAR

One of the main threats to coral reefs are tourists, who want to bring home coral souvenirs from their tropical vacations.

Mangrove Trees: Up to Their Knees in Salty Seas

Students will construct a model of a coastal ecotone and identify the importance of mangroves in the tropics (55 minutes).

CONCEPT: Ecotones are areas where two ecosystems overlap and support great species diversity.

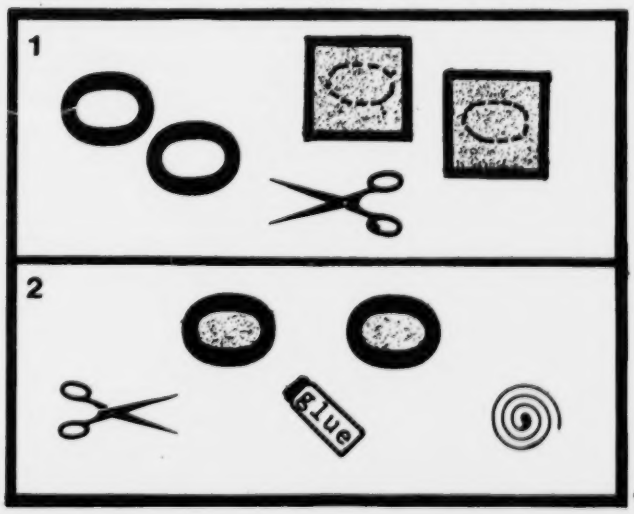
OBJECTIVES:
(1) Define ecosystem.
(2) Define ecotone.
(3) Construct ecotone model.
(4) Define mangroves and identify areas on map.
(5) List (5) ideas for preservation of mangrove ecosystems.

MATERIALS
- Mangrove Map* • heavy cardboard
- scissors • glue • tape
- black acetate pens (Staedtler)
- two large sheets of acetate (two different light colors)
- scratch paper • pens/pencils

BACKGROUND: See "Common Concerns" and "Bringing Up Baby."

PREPARATION:
1. Copy maps of mangrove areas.

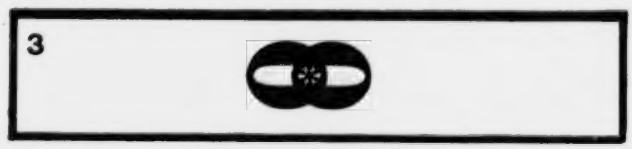
2. Cut out two 2-inch round frames (19 inch diameter or more) from the cardboard. Then cut acetate circles to cover these cardboard frames. (Each frame should have a different color.) Glue the acetate around the edges to the cardboard frames. Add tape around the edges for a border.



PROCEDURE:
1. Define ecosystem and ask students to give examples. Define species. Explain that different animal and plant species live in different habitats, because they have adapted to different ecosystems. Ask students to give specific examples.

2. Divide the students into two groups. Hold up the two acetate/cardboard pieces. Explain that these represent two different ecosystems. Each group's task is to add the species to the ecosystem by each child drawing a different plant or animal on the acetate. Instruct the students to think about his or her species and to practice drawing it on scratch paper before using the marker on the acetate. (Note: You can make these ecosystems real or imaginary.)

3. Once all the students have added their species to the pieces of acetate, collect the two pieces and ask for two volunteers -- one from each group -- to hold up the ecosystems in front of the class. Explain that there are no strict boundaries between different ecosystems, but instead there are transition zones. Define ecotone as a transition zone where two ecosystems overlap. Demonstrate this concept by instructing the volunteers to overlap the two ecosystems as this diagram shows.



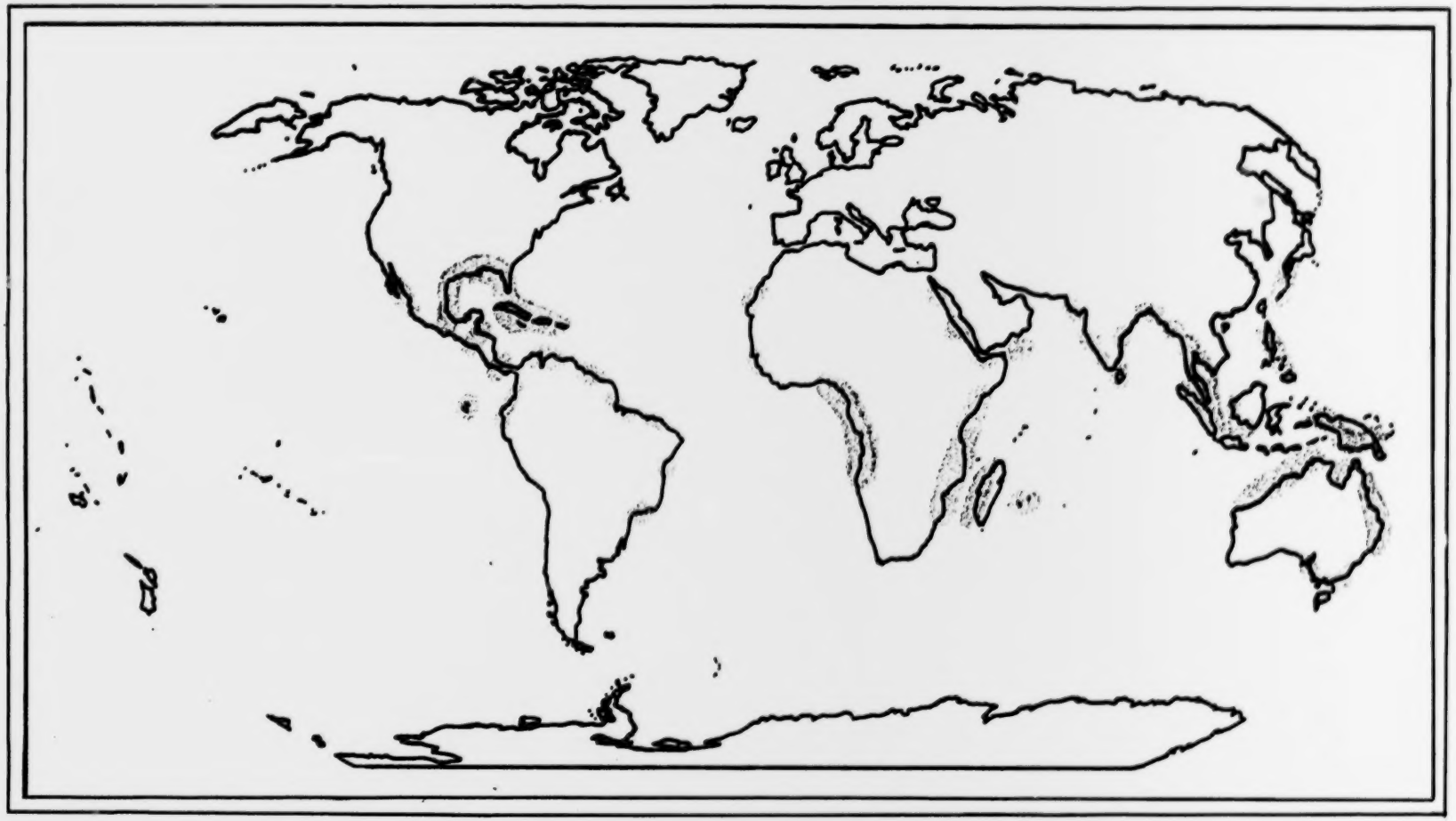
4. An example of an ecotone is a mangrove ecosystem. Describe the mangrove ecosystem and explain that they are very rich in species diversity. Define species diversity. Referring to the model of the overlapping ecosystems, ask the students to explain why there is great species diversity in the mangrove ecosystems or <u>any</u> ecotone? Distribute map of mangrove areas to the students.

CONCLUSION:

1. Ask the students what will happen to the diversity of species in the ecotone when one of the ecosystems is destroyed? Is it enough to protect just one of the ecosystems?

2. Inform the students that mangrove ecosystems are vital habitats for species, which are rapidly being destroyed due to tropical deforestation, diversion of fresh water, and dredge and fill operations. Brainstorm ideas about ways of preserving the mangrove ecosystems.

MANGROVES



A Sea of Debris

A grab bag of items representing marine debris will help students to identify the sources and harmful effects of non-biodegradable debris on marine species (35 minutes).

CONCEPT:
The marine ecosystem and animals are threatened by debris and other types of pollution.

OBJECTIVES:
(1) Define and compare biodegradable and non-biodegradable debris.
(2) Identify (3) sources of debris.
(3) List (5) options for reducing marine debris.
(4) Create a poster about marine debris as a group project.

BACKGROUND: See "Common Concerns."

SUBJECT	SKILLS
• Art	• creativity
• Natural Science	• identification
• Social Science	• application
	• synthesis

MATERIALS

- one large brown bag
- assorted debris items
- poster board
- glue
- tape
- crayons

PREPARATION:
1. Collect materials for the grab bag. A suggested list includes:

BIODEGRADABLE	NON-BIODEGRADABLE
leaf	aluminum can
stone	six-pack ring
twig	styrofoam cup
nut	plastic bag
pine cone	milk carton
bone	fishing line

PROCEDURE:
1. Arrange the students in a circle. Define biodegradable. Hold up the grab bag and explain that all the items in the bag are examples of litter or debris that are often found around coastal areas.

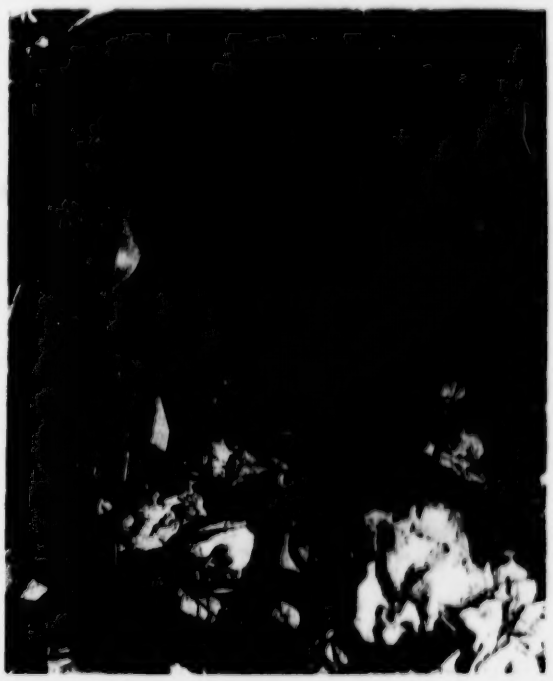
2. Instruct the students that the bag will be passed around the circle and each student will pick out one item from the bag. Each student will be responsible for answering 3 questions about his or her item.

a) Is it biodegradable?

b) Where could it have come from?

c) Is it beneficial, harmful, or neither to marine species, including fish, birds, reptiles, and mammals?

3. After all the students have answered the questions, discuss various options for eliminating or reducing non-biodegradable debris from the coastal environment.



CONCLUSION:

1. Divide the students into 3-4 groups. Instruct them to create a poster describing the hazards of marine debris and how to stop this pollution - using their pieces of debris. Display these in the classroom or school.

* Many states have passed legislation that require six-pack rings be biodegradable. Find out the status of this measure and other ways of recycling wastes in your state and local area.

Wave of the Future

After diagraming various food chains, students will discuss the benefits and drawbacks to the technology of aquaculture (40 minutes).

CONCEPT:
Marine resources provide humans with a vital source of energy and food supply.

OBJECTIVES:
(1) Define food chain.
(2) Diagram marine resource food chain.
(3) Define aquaculture.
(4) Identify (3) pros/cons of utilizing aquaculture.

BACKGROUND: See "Common Concerns."

SUBJECT	SKILLS
• Natural Science	• comprehension
• Economics	• analysis
• Social Science	• synthesis

MATERIALS
• pens/pencils • blackboard
• paper

PREPARATION:
1. Distribute paper and pens or pencils.

PROCEDURE:
1. Define food chain. Identify the source of all energy. Describe how energy is lost each time a transfer in the food chain is made. Ask the students to diagram a food chain using the following elements: people, plants, fish, and the sun. Discuss the diagrams.
2. Now ask the students to illustrate a food chain using the following elements: sun, fish, plants, people, and cows. Discuss the diagrams. Explain that 1/3 of the global fish catch goes into animal feed, which is then consumed by people. Is this an efficient use of marine resources and food energy?

3. Introduce and define aquaculture as the controlled cultivation and harvest of aquatic plants and animals. This idea of farming fish in contained areas is becoming increasingly popular as a more efficient way of extracting marine resources and energy for human consumption.

CONCLUSION:
1. Analyze possible benefits and drawbacks of this experimental technology and keep a list of points on the blackboard.

Could aquaculture be used to aid in solving the problem of the world's hungry?

Could aquaculture prevent the overharvesting of marine resources?

Could aquaculture help protect fertile land from overgrazing?

What could happen to the critical coastal areas?

How could industrialized and developing nations cooperate on sharing the benefits of aquaculture?

COLOR ME